TOTAL MAXIMUM DAILY LOAD (TMDL)

For Suspended Solids and Turbidity for English Bayou (subsegment 030702) in the Calcasieu River Basin

US EPA Region 6

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English Bayou in the Calcasieu River basin is listed for suspended solids and turbidity. A basin approach was used in developing this TMDL. This approach is most appropriate when addressing predominately nonpoint source issues such as sediment where inputs are distributed throughout the basin. TSS loads that will allow compliance with state established turbidity standards, have been calculated from relationships established with data from English Bayou.

The TMDL establishes a relationship between the two specific listings relating them both ultimately to the primary concern of sediment load. Turbidity criteria have been adopted in the State's Water Quality Standards. Target load estimates were developed from regression analysis relationships between turbidity and total suspended solids (TSS) measurements. TSS loads that will allow compliance with State established turbidity criterion for the basin have been calculated for English Bayou. This TMDL establishes that fluvial erosion processes in the basin are by far the dominant contributor to these measured parameters. Therefore, this TMDL addresses inorganic suspended solids (i.e., soil and sediment particles from erosion or sediment resuspension) rather than organic suspended solids associated with discharges from point sources.

In the Calcasieu River basin TMDL, water quality monitoring stations on English Bayou with historical water quality data were evaluated to establish a basin relationship between turbidity and TSS. A mathematical expression of this relationship was developed and used to calculate TSS values that, if met, would allow compliance with the turbidity standards in that basin and reduce the potential for formation of bottom deposits. Because point source contribution of inorganic suspended solids were considered negligible, load allocations for nonpoint source contribution of TSS were set equal to the total allowable loads. An explicit margin of safety of 20% was also incorporated in this TMDL. A Necessary reduction of 38% in total suspended solids during the wet season (December through May) is needed in order to meet the established target.

1. Introduction

Section 303(d) of the Clean Water Act as amended by the Water Quality Act of 1987, and EPA's regulations under 40 CFR Part 130 require that each state identify those waters within its boundaries not meeting water quality standards. Section 303(d) of the Federal Clean Water Act further requires that states develop TMDL management plans for water bodies determined to be water quality limited. A Total Maximum Daily Load (TMDL) documents the amount of a pollutant a water body can assimilate without violating the State's water quality standards. It also allocates that load capacity to known point sources and nonpoint sources. TMDLs are defined under 40 CFR Part 130 as the sum of the individual Waste Load Allocations (WLAs) for point sources, Load Allocations (LAs) for nonpoint sources including man-made and background conditions, and a margin of safety (MOS).

2. Study Area Description

2.1 General Information

The Calcasieu River Basin is located in southwestern Louisiana and is positioned in a north-south direction. The drainage area of the Calcasieu Basin comprises approximately 3,870.7 square miles. Headwaters of the Calcasieu River are in the hills west of Alexandria. The Calcasieu River flows south for about 160 miles to the Gulf of Mexico; the mouth of the river is about 30 miles east of the Texas-Louisiana state line. The landscape in this basin varies from pine- forested hills in the upper end to brackish and salt marshes in the lower reach around the Calcasieu River. The English Bayou subsegment is 89.4 square miles or 2.3% of the Calcasieu River Basin. The Calcasieu Parish comprises 95% of the English Bayou watershed and the Jefferson Davis Parish comprises the remaining of 5%. The average annual rainfall in the English Bayou subsegment is 59.06 inches with a runoff of 18.77 inches. Table 1 lists the land uses and their respective areas.

Table 1. Land Use (km^2) in the English Bayou watershed

Coverage Type	Area km2	Percent of watershed
row crops/small grains	149.98	64.40
urban	34.05	14.62
deciduous forest	14.34	6.16
evergreen forest	8.55	3.67
other	6.33	2.72
pasture/hay/grasslands	5.36	2.30
mixed forest	5.27	2.26
water	4.22	1.81
forested wetland	3.99	1.71
non-forested wetland	0.79	0.34
Total	232.88	100.00

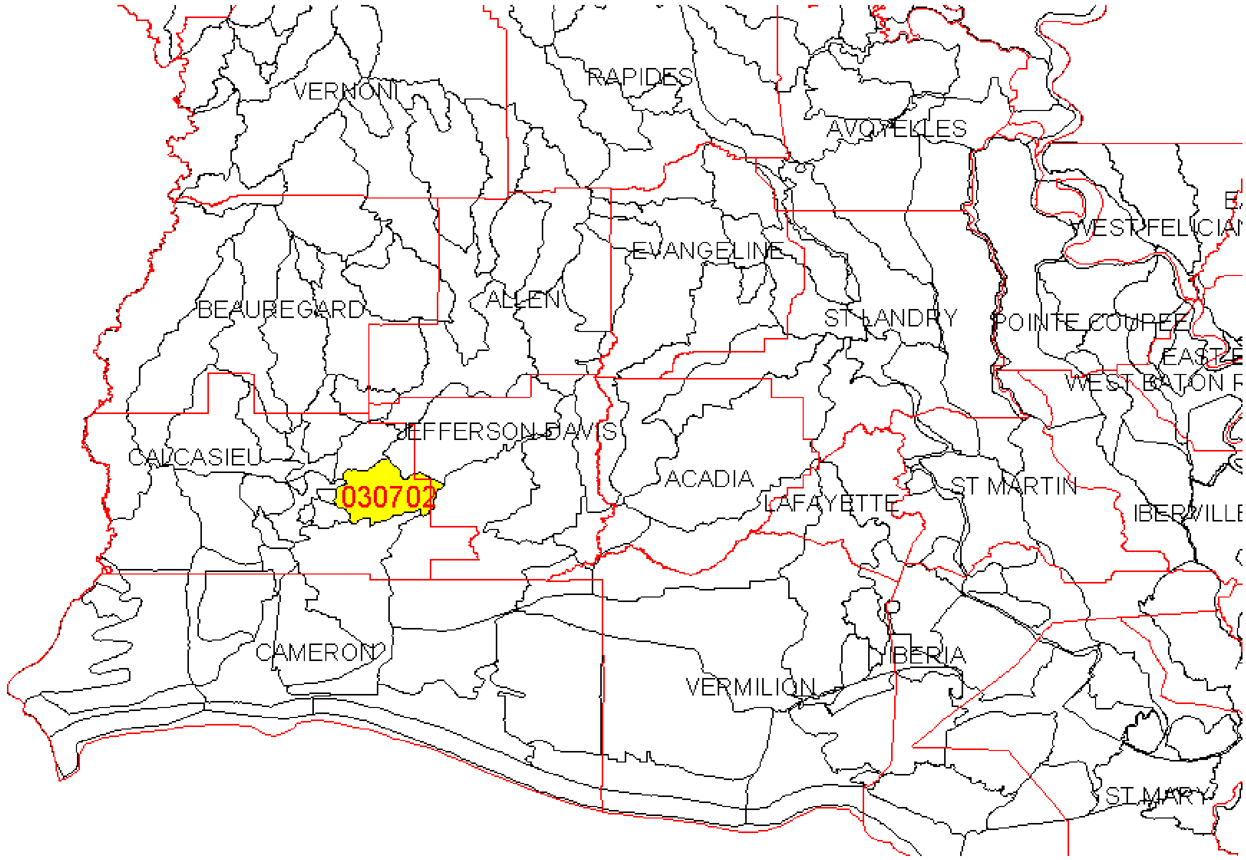

Figure 1. Map of the English Bayou watershed.

2.2 Problem Statement

English Bayou was included on the Louisiana 303(d) list as not fully supporting the water quality standard with suspended solids and turbidity as the cause of nonsupport. Assessments for turbidity were based on monitoring data collected by LDEQ. Assessments for suspended solids were based largely on the best professional judgment of the Louisiana Department of Environmental Quality (LDEQ) regional coordinators, often without the benefit of quantitative data. Informal, qualitative visual observations, not quantitative data, were the basis for many of these listings.

2.2.1 Turbidity and TSS

Turbidity is the measure of the optical property of water that causes light to be either scattered or absorbed. Turbidity may be influenced by a number of factors but is primarily affected by suspended matter such as clay, silt, plankton, or microscopic organisms (APHA, 1992). These constituents are the same components that would contribute to TSS. Although turbidity may be influenced by other factors, effects due to TSS will be captured in a turbidity measure.

The State of Louisiana has established acceptable numeric turbidity standards for many of its streams including those in the Calcasieu River Basin. The State has not established a numerical criterion for TSS. Given that there is no criterion for TSS in the Louisiana water quality standards and that there is a moderate relationship between turbidity and TSS as evidenced by the correlation coefficient of 0.58, a listing under both parameters is considered here to be duplicative. A review of the origin of these listings also provides support for this argument. Turbidity listings on the 303(d) list almost always originated from the State's 305(b) or 303(d) lists while siltation and TSS listed waters originated largely from the State's nonpoint source list.

2.2.2 Siltation

Numerous waters are included on the Louisiana 303(d) list as impaired due to siltation. As with TSS, there are no numeric guidelines or criteria for siltation and there is little or no existing information available that would allow a direct evaluation of stream substrate conditions. Louisiana's water quality standards provide a link between suspended solids and bottom deposits, stating that floating, settleable, and suspended solids shall not be present in quantities sufficient to cause long-term bottom deposits. For siltation, a water column measure, or indicator, may be used as a quantitative expression of water quality impacts. A water column characteristic that has been widely used as an indicator of the potential for sediment accumulation in streambeds is suspended sediment (EPA, 1999). Siltation may be described as the effect created as suspended matter from the water column settles to the stream bottom. Water column data for TSS is available from the Louisiana water-quality monitoring network. In this TMDL, TSS is used as an indicator for siltation or bottom deposits resulting from inorganic sediment loads.

2.3 Water Quality Standards

Designated uses for English Bayou are primary contact recreation; secondary contact recreation; propagation of fish and wildlife and agriculture.

Numeric criterion for turbidity may be found in the Louisiana Water Quality Standards at §1113.B.9. This reads:

"Turbidity

a) Turbidity other than that of natural origin shall not cause substantial visual contrast with the natural appearance of the waters of the state or impair any designated water use. Turbidity shall not significantly exceed background; background is defined as the natural condition of the water. Determination of background will be on a case-by-case-basis.

b) As a guideline, maximum turbidity levels, expressed as nephelometric turbidity units (NTU), are established and shall apply for the following named water bodies and major aquatic habitat types of the state:

i.) Red, Mermentau, Atachafalya, Mississippi, and Vermilion Rivers and Bayou Teche—150 NTU;
ii.) Estuarine lakes, bays, bayous, and canals—50 NTU;
iii.) Amite, Pearl, Ouachita, Sabine, Calcasieu, Tangipahoa, Tickfaw, and Techefuncte Rivers—50 NTU;
iv.) Freshwater lakes, reservoirs, and oxbows—25 NTU;
v.) Designated scenic streams and outstanding natural resource waters not specifically listed in Subsection B.9.b.i-iv of this Section—25 NTU;
vi.) For other state waters not included in Subsection Bl.9.bi-v of this Section, and in waterbody segments where natural background turbidity exceeds the values specified in these clauses, turbidity in NTU caused by any discharges shall be restricted to the appropriate background value plus 10 percent. This shall not apply to designated intermittent streams."

Narrative criteria related to the water quality characteristics for TSS and siltation are found at §1113.B.3. This reads:

> "Floating, Suspended, and Settleable Solids. There shall be no substances present in concentrations sufficient to produce distinctly visible solids or scum, nor shall there be any formation of long-term bottom deposits of slimes or sludge banks attributable to waste discharges from municipal, industrial, or other sources including agricultural practices, mining, dredging, and the exploration for and production of oil and natural gas. The administrative authority may exempt certain short-term activities permitted under Sections 402 or 404 and certified under Section 401 of the Clean Water Act, such as maintenance dredging of navigable waterways or other short-term activities determined by the state as necessary to accommodate to legitimate uses or emergencies or to protect the public health and welfare."

Narrative criteria related to the water quality characteristics for Biological and Aquatic Community Integrity are found at §1113.B.12. This reads:

> "Biological and Aquatic Community Integrity. The biological and community structure and function in state waters shall be maintained, protected, and restored except where not attainable and feasible as defined in LAC 33:IX.1109.B.3. This is the ideal condition of the aquatic community inhabiting the unimpaired water bodies of a specified habitat and region as measured by community structure and function. The biological integrity will be guided by the fish and wildlife propagation use designated for that particular water body. Fish and wildlife propagation uses are defined in LAC 33:IV.1111.C. The condition of these aquatic communities shall be determined from the measures of physical, chemical, and biological characteristics of each surface water body type, according to its designated use (LAC 33:IX.1123). Reference site conditions will represent naturally attainable conditions. These sites should be the least impacted and most representative of water body types. Such reference sites or segments of water bodies shall be those observed to support the greatest variety and abundance of aquatic life in the region as is expected to be or has been recorded during past surveys in natural settings essentially undisturbed by human impacts, development, or discharges. This condition shall be determined by consistent sampling and reliable measures of selected, indicative communities of animals and/or invertebrates as established by the office and may be used in conjunction with acceptable chemical, physical, and microbial water quality measurements and records as deemed for this purpose."

2.4 Target Determination

To develop a TMDL it is necessary to establish quantitative measures, or indicators, that can be used to quantify the relationship between pollutant sources and their impact on water quality. Once an indicator has been selected, a target value for that indicator which distinguishes between the impaired and unimpaired state of the water body (e.g. 25 mg/L TSS, or no more than 1000 tons/year sediment yield on average) must be established (USEPA, 1999). Often indicators needed to establish a TMDL are specified as a water quality standard. For example, turbidity no greater than 50 nephelometric turbidity units (NTU) has been adopted as part of the State's water quality standards. Often the water quality standard, as in the case with bottom-deposits, is established as a narrative with no associated numeric value. When such numeric values are not available, a target value must be developed for the selected indicator. Where such target values that are representative of the narrative standard are developed, the targets themselves are not water quality standards; rather, they are water body-specific numeric targets used by EPA to assess if a water body would be reasonably expected to be impaired based on the State's narrative standard. In this case the narrative standard addresses suspended solids and its relationship to formation of stream-bottom deposits, but does not establish a numeric value for its evaluation.

EPA developed target values or screening levels do not represent a water quality criterion or standard; rather, it is a numeric target used by EPA to assess if a water body would be reasonably expected to be impaired based on the State's biological and aquatic community integrity narrative criterion.

As previously stated, one method of establishing a TMDL target is to establish a relationship between two measured parameters, one of which has a numeric standard. These TMDLs have been developed using an established relationship between turbidity and TSS. Where such functional relationships are used, they must be derived based on site-specific or comparable reference data.

2.4.1 Establishing the relationship

Fifteen years (1984 – 1999) of historical water quality data collected by LDEQ from established subsegment monitoring stations were evaluated. Only data for which both turbidity and TSS were measured simultaneously were applicable. The period of record for each station and data set is shown in Appendix A.

Trends in historical turbidity were analyzed by year and month. In any given year, the majority of the turbidity values are less than 100; however, there are occasional extreme values in any given year. Out of the 180 sampling events, the turbidity standard (50 NTU) is exceeded in 55 sampling events or 30% of the time. A review of the monthly trends in turbidity during the 15-year period reveals a definite seasonal pattern. The highest turbidities occur from December through May, or wet season and the lowest values occur in the second half of the year, June through November or dry season. Eighty-eight percent of the run off occurs in the wet season and 12% occurs during the dry season. Furthermore, the 50 NTU standard is not exceeded during the dry season. Annual turbidity values, monthly trends, and other exhibits for this paragraph are shown in Appendix B.

Trends in historical TSS were analyzed by year and month. The annual TSS concentrations are typically less than 50 mg/l; however, there are few extreme concentrations during the 15-year period. Seasonal trends are not as evident for TSS as for turbidity; but nevertheless are present. Annual TSS values, monthly trends, and other exhibits for this paragraph are shown in Appendix C.

Correlation and simple linear regression analyses were used to determine the relationship between turbidity and TSS. In order to meet the normality assumption of linear regression, it was necessary to log transform the data prior to any regression analyses. The regression analyses were run on the entire data set, as well as the data for each season. Because there was no significant difference in the predicted TSS using the resulting regression equations, only the single equation representing the entire data set was used. A log-log scatter plot of TSS vs. turbidity was created as shown in Appendix D. The plotted points of turbidity and TSS follow a discernable linear pattern in which TSS increases as turbidity increases. This is expected as indicated in our previous discussion of TSS and turbidity. The strength of this relationship is measured using the correlation coefficient (r). As the value of r approaches one, the relationship is said to have a high correlation and thus a strong relationship. The correlation coefficient for the English Bayou data is 0.58. Therefore, there is a moderate correlation or relationship between turbidity and TSS for English Bayou. Consequently, a meaningful mathematical expression of this relationship can be established using simple linear regression.

A scatter plot using the log TSS vs. log turbidity was created to show the relationship between the two parameters. A "best fit line" through the points on the graph provides a visual representation of the mathematical equation from the regression analysis. This line is expressed mathematically by the general formula, $\log y = b (\log x) + c$, where $\log y$ is the predicted TSS concentration or dependent variable, $\log x$ is the standard or observed value for turbidity or the independent variable, b is the slope of the line and c is a constant. The resulting regression equation was statistically significant (p-value $\leq$ 0.0001, alpha = 0.05). Applying the equation given in Table 2, a target TSS concentration can be calculated by substituting the log of the turbidity standard of 50 NTU (3.912023) for x and solving the equation for log y. The resulting log y value (3.1680) must be back-transformed to its original format by taking the inverse log. The back-transformed value of 24 is the target TSS value (mg/l) that would allow for compliance with the turbidity standard of 50 NTU.

Table 2. Regression equation for English Bayou

Regression Equation	R^2	p-value
$\log y = 0.5467 (\log x) + 1.0293$	0.3367	1.29E-06

The strength of the linear relationship is measured by the coefficient of determination (R^2) calculated during the regression analysis (Zar, 1996). Therefore, the R^2 value is the percentage of the total variation in log y (TSS) that is explained or accounted for by the fitted regression (log x). Therefore, 34% of the variation in TSS is accounted for by turbidity and the remaining 66% of variation in TSS is unexplained. The unexplained portion is attributed to factors other than turbidity such as chlorophyll *a*, color and bacteria. Rarely in regressions using natural biological systems is the change in one variable shown to be determined 100% by the change in the second variable. Natural systems are complex with many contributors that have various interactions. Purely mathematical manipulations of the standard water quality readings do not readily indicate why TSS and turbidity do not change at the same rate with each pair of samples. This indicates a need for research into these natural systems to establish these complex relationships.

Table 3. Current ambient conditions and target values.

Season	Turbidity Standard NTU	Current Ambient NTU	TSS Target (mg/l)	Current Ambient TSS (mg/l)
Dec - May	50	69.21	24	30.99
Jun - Nov	50	21.2	24	18.63

2.5 Pollutant Sources

A pollutant may be the result of a number of different types of activities that occur within a watershed. Generally these activities can be separated into two groups, point and nonpoint sources. A discussion of the major nonpoint and point source activities that may result in sediment loads follows.

2.5.1 Nonpoint Sources

Two primary sources of TSS and sediment are erosional processes in the watershed and resuspension of bottom deposits to the water column. Particulate matter resulting from the weathering of host rock is delivered to stream channels through various erosional processes, including sheetwash, gully and rill erosion, wind, landslides, dry ravel, and human excavation. Additionally, sediments are often produced as a result of stream channel and bank erosion and channel disturbance. Movement of eroded sediments downslope from their points of origin into stream channels and through stream systems is influenced by multiple interacting factors. Eroded sediments are often trapped on hill slopes and stored in and alongside stream channels (US EPA, 1999). During high flow events stored sediment becomes mobilized and suspend in the water column. As the flow decreases the suspended solids settle downstream. Settled suspended solids (bottom sediment) can become resuspended in the water column during times of increased stream flow and by wind and wave action in shallow lakes.

The most significant source of TSS and sediment in this basin is suspended solids in wet weather runoff. Much of this sediment load comes from areas of the basin that have developed agricultural uses. Land use analysis shows that 64.4% of the land in the watershed is in cropland either as small grains or row crops.

The anthropogenic effects on the land for the generation of sediment, which is measured in TSS, are greatest in agriculture/silviculture. Generally, in order of effect are the land uses row crop, small grains, pasture and forest. The row crop, land use allows more opportunity for the use of a cultivator for weed control. This process has positive effects of reducing surface soil compaction that increases infiltration of rainfall and a small increase in the residue cover from the weeds. This process has negative effects of loosening the soil to facilitate the movement of soil particles. Row crops have less leaf cover during a portion of the growing season compared to small grain crops. The small grain crops have a higher density of plants per area than row crops, which protects the ground from the effects of raindrops, and the closer root structure, which help to protect the soil particles from the effect of runoff. The Louisiana Nonpoint Source Management Plan (LDEQ, 2000) lists BMPs for cropland for sediment. An assessment was made of the current level of implementation of BMPs in the parishes affected by these impaired subsegments. The level and types of BMPs implemented vary by parish. When the implementation plan is developed, the results of ongoing studies should improve the targeting and prioritizing of efforts. In general a higher level of conservation or no till, improved filter/buffer strips and crop residue use appear to be the where the largest gains can be made.

The anthropogenic effects on the pasture, land use are related to the type and height of vegetation, grazing practices and watering practices. A tall dense mass of vegetation will retain more sediment than a short mown lawn like area. Grazing practices will effect the height and density of the vegetation, and determine the amount of cover for normal travel paths. Watering practices will determine if stream banks will be worn down by livestock accessing the stream and resuspending sediments with their traffic. The Section 319 Nonpoint Source National Monitoring Program (Lombardo, 2000) has had several projects with dramatic reductions in sediment from grazing operations that use fencing to control access to the streams and allow natural growth in a buffer area (Lombardo, 2000). The monitoring program has shown that even small areas can contribute to the subsegment's impairment if BMPs are not followed. In general the BMPs where the largest gains can be made are critical area planting, improved filter/buffer strips and fencing.

The anthropogenic effects on the various forest, land uses are related to the harvesting of forest products. The reduction of cover in the cleared areas lasts for two years. These disturbed areas are the source of most of the contribution to sediment in the forest, land uses. Access roads and stream crossings are another source of sediment in the forest areas. In general the BMPs where the largest gains can be made are streamside management zone items and timber harvesting items.

2.5.2 Point Sources

Point sources do not represent a source of TSS as defined in this TMDL. Wastewater treatment facilities discharge primarily organic TSS, which does not contribute to extensive habitat impairment resulting from sedimentation. The organic TSS is a non-conservative constituent that would only be detected as a component in proximity to the discharge point. Municipal permits contain a TSS limitation and a specific narrative requirement to prevent organic solids accumulation. Because an enforceable mechanism is in place to protect from discharges of organic suspended solids no TMDL is required for these materials.

This TMDL only addresses geomorphic contributions of TSS/sediment. Some discharges classified as point sources, such as construction sites, permitted through general permits, can discharge erosional sediment loads. These sites are transient in nature, because they cover only the construction activities at the site; once construction is complete these permits expire. These permits require implementation of BMPs and other requirements designed to reduce sediment load as a result of the permitted activity. Large-scale construction activities are most often found in areas associated with urban development. Land use in the impacted subsegments addressed in this TMDL is dominated by agricultural uses. Urban land use in the affected subsegment is only 14.62% of the total land. Given this minimal urban use it is not expected that construction activities are a major source of TSS as defined in this document. For purposes of this TMDL the explicit margin of safety will be sufficient to address any uncertainties associated with sediment loads resulting from permitted construction activities.

3. TMDL Load Calculations

3.1 Calculation of Loads

Load allocations are calculated by first calculating the allowable load as expressed by the TSS target concentration. This is accomplished by the formula:

Load (lbs/day) = Flow (mgd) * TSS concentration (mg/L) * 8.34

where 8.34 is a constant for unit conversions and TSS target and ambient concentration is taken directly from Table 3. To address the issue of uncertainty each calculated target value has been reduced by 20%. Values shown in Table 4 reflect this reduction. This will be used as an explicit MOS. The resulting values are shown in Table 4.

The flow was calculated based on the area of the subsegment and a runoff depth that predicts volume that will flow out on an area in a given amount of time. The runoff depth was taken from the Mean-Monthly Water Budget Summary and State division map provided by the Louisiana Office of State Climatology (LOSC, 2001). The State division map indicates the division boundaries and the parishes in each division. For English Bayou, the area is 89.4 square miles, the runoff is 18.77 inches per year and the calculated average daily flow is 79.89 mgd.

3.2 Total Maximum Daily Load for Turbidity and TSS

This TMDL for turbidity is expressed in terms of percent reduction needed to achieve the turbidity standard for English Bayou. No reduction in TSS is required for English Bayou during the dry season from June through November; however, a 38% reduction in TSS is required during the wet season from December through May.

This TMDL for TSS is expressed in terms of pounds per day needed to achieve the target TSS load for English Bayou and is shown in Table 4. The target TSS concentration is expressed in mg/L in Table 3.

Table 4. Calculation of TMDL, MOS and Current Condition Loads

Season	Flow MGD	TMDL Loading (lbs/day)	MOS (lbs/day)	LA (lbs/day)	Ambient Stream Loading (lbs/day)	Percent Reduction
Dec - May	63.91	12,792	2,558	10,234	16,518	38%
Jun - Nov	15.98	3,199	640	2,559	2,483	0%

3.3 Seasonal Variation

Section 303(d)(1) requires that all TMDLs be "established at a level necessary to implement the applicable water quality standard with seasonal variations". Seasonal variability was considered in calculating the current condition TSS values. A review of the data shows that values greater than the target values are more likely to occur in the months of December through May. Because of this uneven distribution it was determined that two periods December to May and July to November would be used for establishing the current condition. The 5-year average (1995-1999) of the data for these two periods was taken to represent the current condition. This approach addresses the critical period for TSS loading. Graphs are provided in Appendix C.

3.4 Margin of Safety

The Clean Water Act requires that each TMDL be established with a MOS. This requirement for a MOS is intended to account for uncertainty in available data or in the actual effect controls will have on the loading reductions and receiving water quality. A MOS may be expressed explicitly as unallocated assimilative capacity or implicitly through conservative analytical assumptions used in establishing the TMDL. The MOS is not intended to compensate for failure to consider known sources. An explicit MOS of 20% is expressed in this TMDL and shown in Table 4.

4. Reasonable Assurance and Other Relevant Information

LDEQ receives federal funding under the Clean Water Act Section 319(h) Nonpoint Source program. The Louisiana Nonpoint Source Management Plan identifies that the LDEQ will continue to work cooperatively with the federal, state and local partners that assist them in implementation of statewide educational programs and basin protection and restoration projects to restore the designated uses of water bodies. The Management Plan also identifies the State's 14 short-term and long-term goals to address nonpoint sources of pollution in the Calcasieu basin in the 2004 to 2015 timeframe. It is anticipated that the State will evaluate if actions have been successful in reducing the nonpoint source pollution in the Calcasieu by the end of 2005. The Louisiana 2001 Nonpoint Source Annual Report (LDEQ, 2002) indicates that actions have begun in the Calcasieu Basin based on completion of at least 7 TMDLs on dissolved oxygen. Two projects are listed as implemented or initiated, which cover forestry and agriculture BMPs needed in response to this TMDL. The annual report shows that 2 projects commit over 1 million dollars in the Calcasieu Basin to reach the short-term and long-term goals. Statewide a total of 88 projects are in some stage of development or implementation. Many of them will have statewide relevance for sectors of the NPS of pollution.

The Louisiana Nonpoint Source Management Plan under Cropland BMPs for sediment concerns in surface water lists 23 practices with 4 of them for irrigated fields. These will be instrumental in meeting the designated uses in the English Bayou subsegment where the cropland percentage is 48%. The forestry BMPs fall under 4 large categories with 69 steps for the practices. These will be instrumental in meeting the designated uses in English Bayou that has 12% forested land. The pastureland BMPs for sediment concerns in surface water lists 16 practices with 3 of them for irrigated fields. The English Bayou watershed is 2.3% pasture, which will make pasture a smaller contributor than cropland.

Based on nonpoint source information gathered (Parsons, 2002) on the two parishes effected by the subsegment covered in this TMDL an estimate was made of the existing extent of current practices. The required reduction to meet the TMDL is 38%. It is reasonable to assume the percentage of implementation of BMP's can be improved to effect the reductions required.

LDEQ utilizes funds under Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act to operate an established program for permitting, enforcement and monitoring the quality of the State's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface-water monitoring program are to determine the quality of the State's surface waters, to develop a long-term database for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface-water monitoring program is used to develop the State's biennial 305(b) report (*Water Quality Inventory*) and the 303(d) list of impaired waters. This information is also utilized in establishing priorities for the LDEQ nonpoint source program.

LDEQ has implemented a basin approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the water body. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been established by the time the first priority basins are monitored again in the second five-year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following establishment of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list. The sampling schedule for the first two five-year cycles is shown below. The Calcasieu River Basin will be sampled again in 2004.

1998 – 2003 – Mermentau and Vermilion-Teche River Basins

1999 – 2004 – Calcasieu and Ouachita River Basins
2000 – 2005 – Barataria and Terrebonne Basins
2001 – 2006 – Lake Pontchartrain Basin and Pearl River Basin
2002 – 2007 – Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.)

5. Public Participation

When EPA establishes a TMDL, 40 C.F.R. § 130.7(d)(2) requires EPA to publicly notice and seek comments concerning the TMDL. EPA prepared this TMDL pursuant to the consent decree, Sierra Club, et al. v. Clifford et al., No. 96-0527, (E.D. La.) signed and entered on April 1, 2002. Federal regulation requires that public notice be provided through the Federal Register and through newspapers in the local area. The Federal Register notice was issued on March 29, 2002 (Volume 67, Number 61, pages 15196 – 15198). This TMDL was also noticed in local newspapers including The Times-Picayune (New Orleans- statewide) and The News Star (Monroe, LA). Comments and additional information were submitted during the 30-day public comment period and revisions were not necessary. Response to comments are made available in Appendix E. EPA will provide notice that this TMDL has been made final, to the court, and to the Louisiana Department of Environmental Quality (LDEQ) and notification that it be incorporated into LDEQ's current water quality management plan.

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APPENDIX A Ambient Monitoring Data

Period of Record for Ambient Monitoring Stations

Station	Station Description	Period of Record
0131	English Bayou near Lake Charles, LA	1984-1998
0841	English Bayou North of Chloe, LA	1999

Seasonal Statistics for Turbidity and TSS

Parameter	Season	N	Mean	Median	Min	Max	Stdev
Turbidity	Dec - May	29	69.21	55.00	25.00	170.00	38.39
Turbidity	Jun - Nov	24	21.20	17.00	6.20	40.00	10.69
TSS	Dec - May	29	30.99	25.00	8.00	140.00	26.45
TSS	Jun - Nov	24	18.63	16.00	4.00	50.00	11.33

English Bayou Data Set

Station	Date	Turbidity	TSS
0131	5/11/1998	45	18
0131	4/13/1998	140	8
0131	3/9/1998	170	60
0131	2/9/1998	45	21
0131	1/12/1998	135	140
0131	12/8/1997	100	10
0131	11/17/1997	28	4
0131	10/13/1997	6.2	11
0131	9/8/1997	13	9
0131	8/11/1997	13	14
0131	7/14/1997	29	15
0131	6/9/1997	40	16
0131	5/12/1997	45	12
0131	4/14/1997	98	28
0131	3/10/1997	35	22
0131	2/17/1997	60	35
0131	1/6/1997	37	25
0131	12/9/1996	36	15
0131	11/18/1996	36	41
0131	10/14/1996	15	8.5
0131	9/9/1996	14	16
0131	8/12/1996	7.1	14
0131	7/8/1996	13	18
0131	6/10/1996	12	50
0131	5/13/1996	31	12
0131	4/8/1996	50	28
0131	3/11/1996	25	28

Station	Date	Turbidity	TSS
0131	5/9/1994	55	21
0131	4/11/1994	60	19
0131	3/14/1994	100	46
0131	2/7/1994	90	37
0131	1/10/1994	52	13
0131	12/13/1993	35	7
0131	11/15/1993	28	31
0131	10/11/1993	6.9	7
0131	9/13/1993	10	5
0131	8/9/1993	17	12
0131	7/12/1993	25	20
0131	6/14/1993	30	10
0131	5/10/1993	76	44
0131	4/12/1993	93	38
0131	3/8/1993	45	14
0131	2/8/1993	44	9
0131	1/11/1993	88	34
0131	12/14/1992	60	29
0131	11/16/1992	17	6
0131	10/12/1992	8.2	12
0131	9/14/1992	10	7
0131	8/10/1992	16	6
0131	7/13/1992	24	30
0131	6/15/1992	41	40
0131	5/11/1992	83	20
0131	4/6/1992	66	42
0131	3/9/1992	68	38

Station	Date	Turbidity	TSS
0131	5/15/1990	44.4	18
0131	4/9/1990	80	24
0131	3/12/1990	88	8
0131	2/12/1990	70	30
0131	1/8/1990	50	58
0131	12/11/1989	18	12
0131	11/13/1989	6.2	18
0131	10/9/1989	10	17
0131	9/11/1989	6.9	10
0131	8/14/1989	17	8
0131	7/10/1989	17	21
0131	6/12/1989	38	6
0131	5/8/1989	116	28
0131	4/11/1989	70	42
0131	3/13/1989	46	16
0131	2/13/1989	35	14
0131	1/10/1989	50	36
0131	12/13/1988	20	28
0131	11/14/1988	15	14
0131	10/10/1988	23	44
0131	9/12/1988	17	14
0131	8/9/1988	14	13
0131	7/11/1988	18	8
0131	6/13/1988	18	8
0131	5/9/1988	105	32
0131	4/11/1988	85	36
0131	3/14/1988	72	65

0131	2/12/1996	55	27
0131	1/8/1996	75	61
0131	12/11/1995	25	12
0131	11/13/1995	25	17
0131	10/9/1995	16	23
0131	9/11/1995	10	8
0131	8/14/1995	18	36
0131	7/10/1995	20	20
0131	6/12/1995	35	33
0131	5/8/1995	40	27
0131	4/3/1995	100	38
0131	3/13/1995	35	22
0131	2/13/1995	50	11
0131	1/9/1995	80	24
0131	12/12/1994	35	16
0131	11/14/1994	16	18
0131	10/10/1994	4.5	10
0131	9/12/1994	23	17
0131	8/8/1994	28	84
0131	7/11/1994	88	148
0131	6/13/1994	22	14
0131	5/12/1986	29	8
0131	4/15/1986	39	20
0131	3/18/1986	16	18
0131	2/18/1986	44	14
0131	1/13/1986	50	20
0131	12/9/1985	40	26
0131	11/18/1985	25	2
0131	9/9/1985	11	10
0131	8/12/1985	12	8
0131	7/9/1985	16	10
0131	6/11/1985	15	2
0131	5/14/1985	90	20
0131	4/9/1985	160	28
0131	3/12/1985	72	36
0131	2/12/1985	238	112
0131	1/15/1985	35	34
0131	12/11/1984	40	26
0131	11/14/1984	38	16
0131	10/9/1984	18	7
0131	9/11/1984	7.1	8
0131	7/10/1984	16	12
0131	6/12/1984	37	18
0131	5/15/1984	80	7
0131	4/10/1984	105	20
0131	3/12/1984	62	30
0131	1/10/1984	70	82

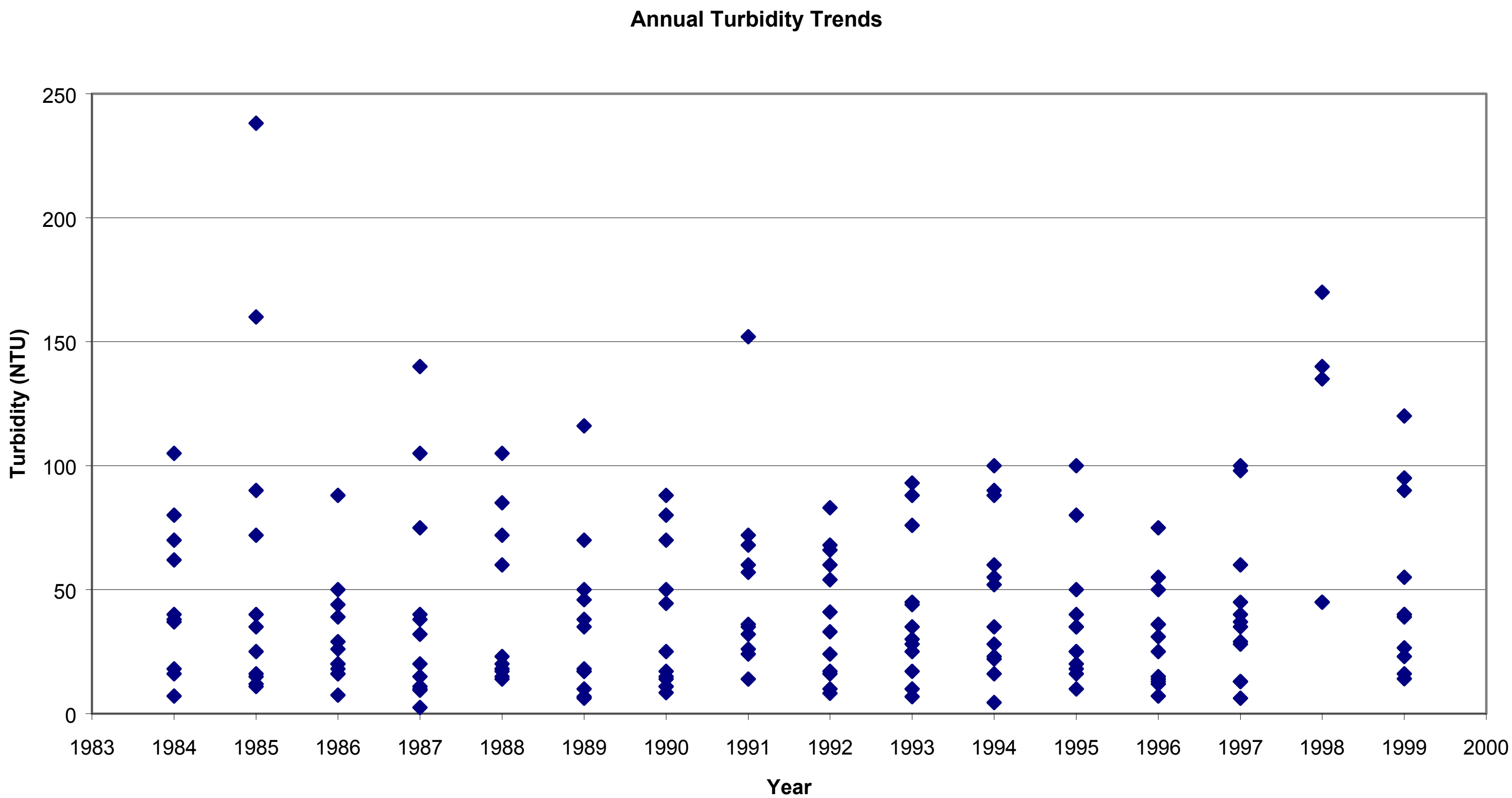
0131	2/10/1992	54	29
0131	1/6/1992	33	20
0131	12/9/1991	35	60
0131	11/19/1991	36	34
0131	10/14/1991	10	621
0131	9/9/1991	14	16
0131	8/12/1991	24	22
0131	7/15/1991	32	16
0131	6/10/1991	26	8
0131	5/13/1991	68	30
0131	4/15/1991	152	168
0131	3/11/1991	72	134
0131	2/4/1991	57	30
0131	1/14/1991	60	28
0131	12/10/1990	8.5	8
0131	11/14/1990	15	22
0131	10/15/1990	11	14
0131	9/10/1990	11	15
0131	8/13/1990	14	9
0131	7/9/1990	17	11
0131	6/11/1990	25	10
0841	12/22/1999	95	47.2
0841	11/17/1999	26.5	10.4
0841	10/20/1999	16	12.5
0841	9/22/1999	23	23
0841	8/18/1999	14.1	6.7
0841	7/21/1999	40	18
0841	6/16/1999	39	23
0841	5/19/1999	90	11.5
0841	4/21/1999	95	42.6
0841	3/17/1999	55	30.3
0841	2/18/1999	120	70
0841	1/20/1999	40	13
0131	2/8/1988	60	24
0131	1/11/1988	40	0
0131	12/14/1987	32	24
0131	11/16/1987	105	150
0131	10/13/1987	11	20
0131	9/14/1987	9.4	11
0131	8/10/1987	10	8
0131	7/14/1987	20	22
0131	6/8/1987	15	4
0131	5/11/1987	140	32
0131	4/13/1987	75	36
0131	3/9/1987	38	26
0131	2/16/1987	40	48
0131	1/12/1987	2.5	6

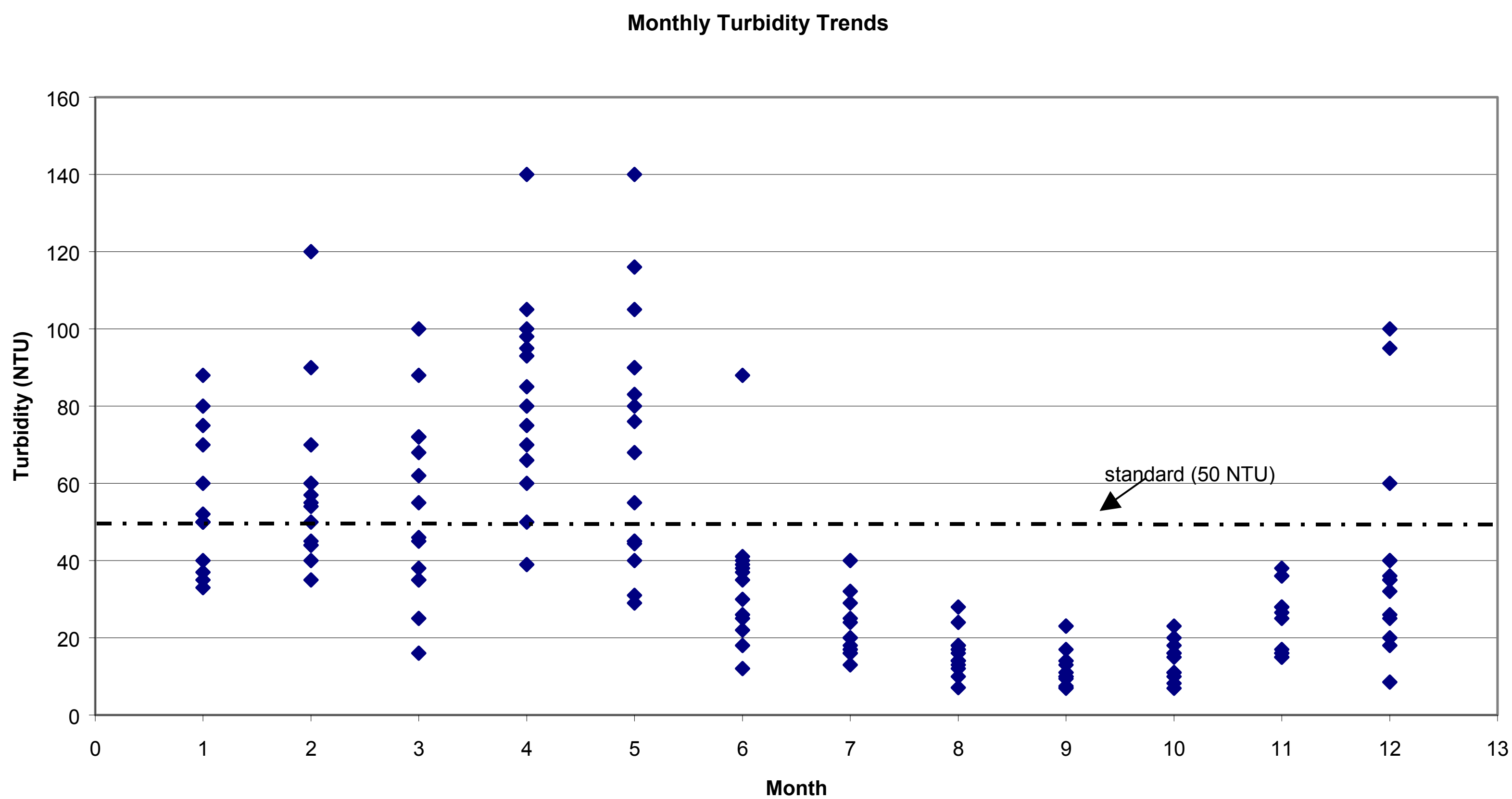
0131	12/8/1986	26	4
0131	11/17/1986	16	12
0131	10/14/1986	20	26
0131	9/8/1986	7.5	12
0131	8/12/1986	18	8
0131	7/15/1986	20	2
0131	6/10/1986	88	22

Legend for Stations

Station	Parish	Description
0131	Calcasieu	English Bayou near Lake Charles, LA
0841	Calcasieu	English Bayou North of Chloe, LA

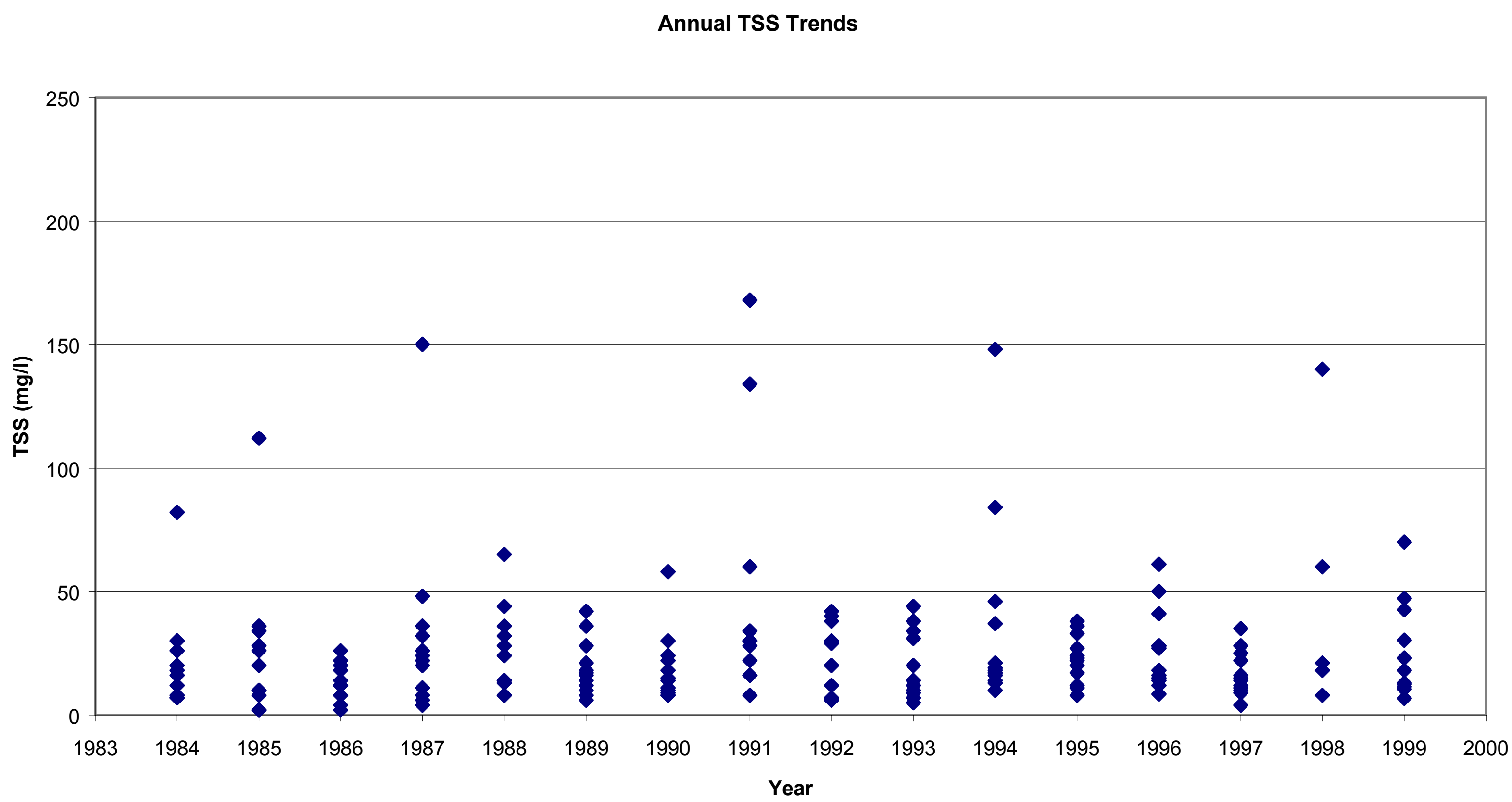
APPENDIX B: Turbidity Graphs

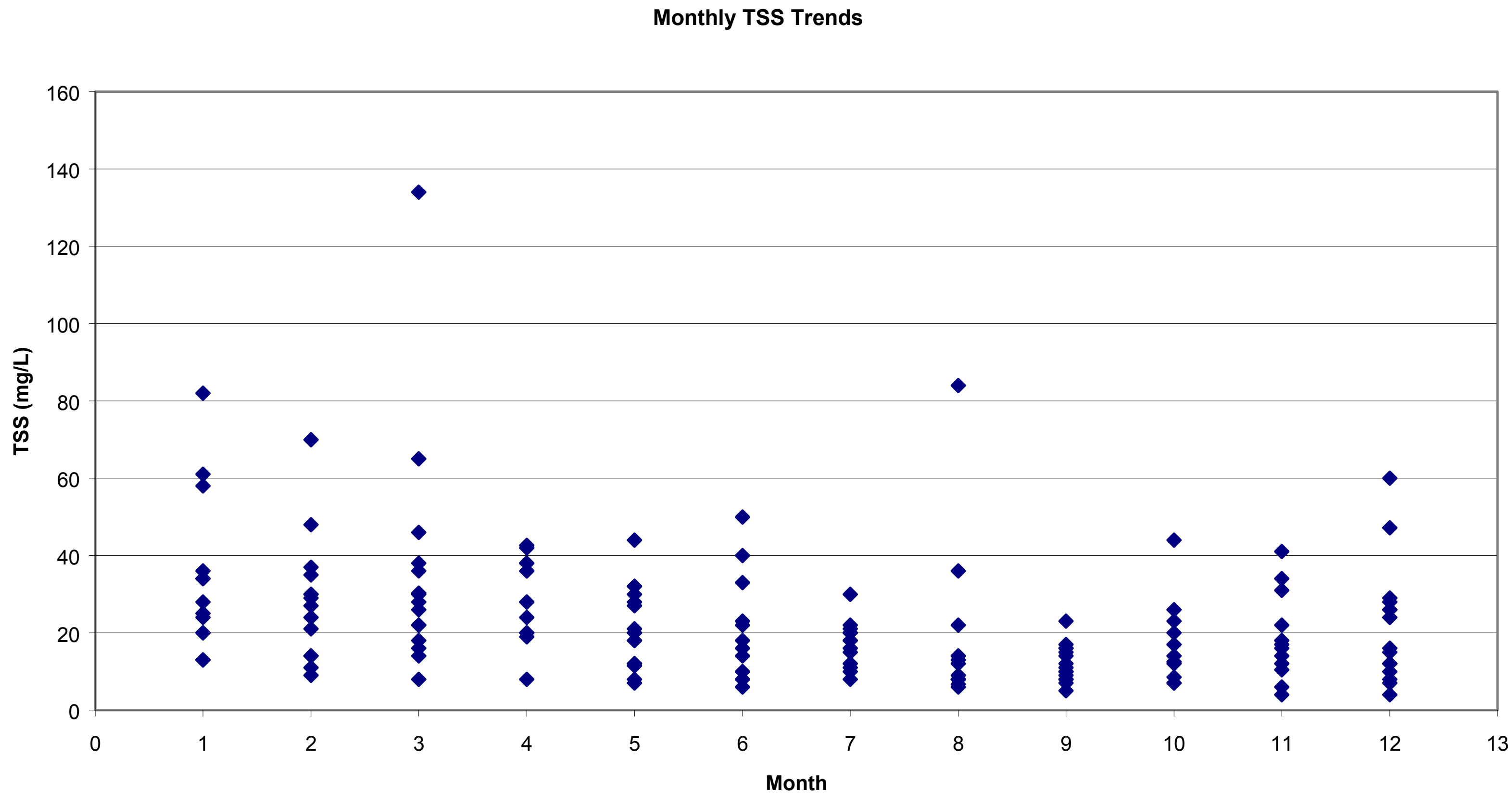




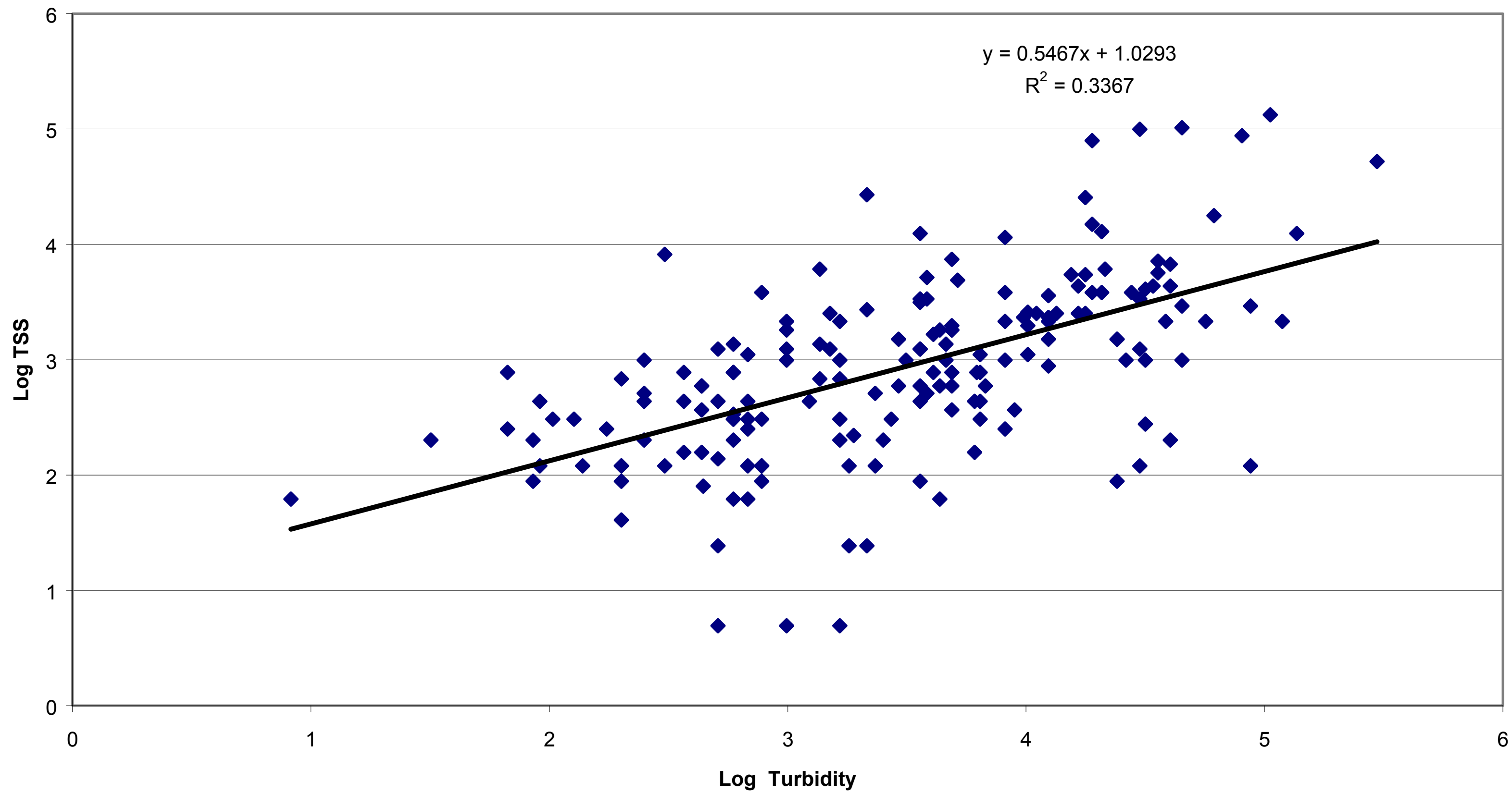
Monthly Turbidity Trends
Turbidity (NTU)
160
140
120
100
80
60
40
20
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Month
standard (50 NTU)

APPENDIX C: TSS Graphs




Monthly TSS Trends
TSS (mg/L)
160
140
120
100
80
60
40
20
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Month

APPENDIX D: Regression Graph



APPENDIX E: Response to Comments

EPA received comments from the Louisiana Department of Environmental Quality in a letter dated April 29, 2002 addressed to Ellen Caldwell. The response to comments specific to Turbidity and suspended solids only are given below.

April 29, 2002

Ms. Ellen Caldwell, Environmental Protection Specialist
Water Quality Protection Division
United States Environmental Protection Agency, Region 6
1445 Ross Avenue
Dallas, Texas 75202-2733

RE: Comments on Federal Register: March 29, 2002 (Volume 67, Number 61) [FRL-7165-6], Clean Water Act Section 303(d): Availability of Total Maximum Daily Loads (TMDLs) and Determinations that TMDLs are not needed for 20 waterbody/pollutant combinations in the Calcasieu and Ouachita river basins.

Dear Ms. Caldwell:

The Louisiana Department of Environmental Quality hereby submits comments on the 98 TMDLs and the calculations for these TMDLs prepared by EPA Region 6 for waters listed in the Calcasieu and Ouachita river basins, under section 303(d) of the Clean Water Act. Listed below are general comments. Refer to the Attachments for specific comments and discussion.

1. It is inappropriate to use non-regulatory "targets" (sediment guidelines or others) as end-points for TMDLs.

2. Incorrect flows were applied in some areas (e.g. harmonic mean was used rather than tidal flows).

3. EPA's use of non-clean technique metals data is inappropriate. Metals data from the Superfund project should not have been used at all since clean sampling and analysis techniques were not used. When EPA did use these data, they were often not applied correctly. For example, Louisiana instream criteria are based on dissolved metals; yet EPA used both dissolved and total metals data to compare to the dissolved criteria. EPA's use of applying total metals to dissolved metals criteria in order to determine exceedance is flawed.

4. LDEQ Ambient Network data should not have been used to justify TMDLs for the same reason as the Superfund data. The available LDEQ data were not collected and analyzed using clean techniques. LDEQ uses these data as a

screening tool to target more intensive sampling and analysis using clean techniques, not for justifying and developing TMDLs.

5. It is inappropriate to assume industries discharge a pollutant when it has not been included in their permit. EPA knows that when effluent limits are determined for each facility based on a number of factors, including the type of facility, types of waste-streams and effluent data submitted during the application process.

6. Monitoring schedules and locations for the different pollutants have been recommended for Louisiana throughout the document; Louisiana will continue its ambient and intensive monitoring programs according to established schedules and agreements.

7. LDEQ's comments concerning specific TMDLs will indicate that EPA has made numerous errors in listing dischargers in the TMDL.

8. The use of sediment data to assess for water quality use impairment and need for TMDLs has no precedent. Neither LDEQ nor EPA has promulgated sediment criteria. Therefore, the use of non- regulatory sediment guidelines and screening values, as Region 6 has done in this report, is not appropriate in assessing for water quality impairment or determining the need for TMDLs.

9. Many of these TMDLs are based on models using historical water quality data gathered at a single or small number of locations rather than survey data gathered at sites spaced throughout the waterbody. The hydraulic information used was generally an average value or estimated value, not taken at the same time as the water quality data. The calibrations are inadequate due to the lack of appropriate hydrologic data and the paucity of water quality data. The resulting TMDLs are invalid. LDEQ does not accept these TMDLs.

We look forward to hearing your response to these comments.

Sincerely,

Emelise S. Cormier
Environmental Scientist Senior
Technology Division

Enclosure(s)

c: Willie Lane
EPA
Region 6

LDEQ COMMENTS ON THE DRAFT TMDLS PUBLISHED BY EPA

LDEQ has reviewed the TMDLs published by EPA on March 29, 2002. One particularly troubling issue for LDEQ is the fact that numerous dischargers that should have been included in these TMDLs were not. This indicates a complete disregard for the discharger inventory LDEQ provided to EPA. At the least, the TMDLs should acknowledge all facilities present in the covered watershed(s) and present the decisions for including or not including them in the TMDL.

In the future, LDEQ requests that EPA provide hard copies of the TMDLs and Appendices for LDEQ review. Hard copies will insure that the complete official document is being reviewed and will eliminate the time required for LDEQ to put together the document from electronic files.

In general, LDEQ found these TMDLs to be unacceptable.

Federal Register Notice: Volume 67, Number 61, pages 15196 - 15198 (3/29/2002)

TURBIDITY AND SUSPENDED SOLIDS

English Bayou Turbidity and Suspended Solids (Subsegment 030702)

1. In reviewing the R^2 values and plots based on EPA's regression analysis, LDEQ does not believe that the correlation between the TSS and turbidity is strong enough to use the turbidity criteria values to develop a numeric criteria for TSS. Thus it is LDEQ's opinion that this analysis is inaccurate and will not produce viable numeric criteria value for TSS. However, LDEQ does believe that there is a relationship between the two parameters. This can be proven by plotting the average monthly values of turbidity versus the average monthly values of TSS. These regression plots give a much better R^2 values and support EPA and LDEQ opinion that these two parameters are indicators of the same water quality concern.

Response: While it is true that a much better R^2 value can be achieved by using the average monthly values of turbidity versus the average monthly values of TSS, EPA believes this is not an appropriate use of regression analysis. Linear regression is intended to describe the relationship between two continuous variables, X and Y. In linear regression, the least squares method is used to determine the relationship between X and Y. This method uses the mean of these variables in its computation. When one averages the X and Y variables over a month and then in turn uses these averages for input into a regression analysis, the variability in the original (actual) data is lost. It is the variability in the original (actual) data that determines the relationship between the X and Y variables. The ultimate purpose of the regression equation is to predict a value for Y when X is known. When using mean values for X and Y then one is in essence predicting a mean Y when a mean X is known. Actual values, rather than mean values are collected in the field. One wouldn't take a monthly mean value to determine whether or not a WQS was being met, but would instead use actual values.

EPA believes that turbidity may be a good predictor of TSS if a greater amount of the variability in the model can be accounted for. The problem seems to stem from the proportion of silt, clay *and sand in the sample. If a sample is high in clay (resistant to settling from the water column), the turbidity value will be large, but the TSS (mg/l) may be small because of the size difference in the particles and their relative weights. Likewise, if a sample is high in sand (readily settles from water column), the turbidity value will be small. All the while, rate of flow compounds the issue. This is an area that needs to be examined in the future.*

2. EPA treated TSS as a conservative parameter in its TMDL calculation. By treating TSS as a conservative EPA is under-calculating the TMDL loads for TSS.

Response: While this may be true, the non-conservative portion of TSS represented by the organic component is very small in most cases. For example, chlorophyll a is measured in micrograms per liter rather an mg/l as is TSS. Therefore,
60 micrograms per liter of chlorophyll a, which would represent a concentration of concern with regard to nutrients, would only account for very small portion (0.6 mg/l) of the TSS. Further more, FTN explored the use of turbidity and chlorophyll a data to predict TSS. They found that including chlorophyll data in the regression analysis did not significantly improve the prediction of TSS and therefore, did not include it in the final equation.